

REMARKS

As a preliminary matter, Applicants request acknowledgement of the Information Disclosure Statement filed June 27, 2002. Another copy of the Form PTO-1449 is enclosed for the Examiner's convenience.

Claim 7 stands objected to because of informalities. Applicants believe that the Examiner was referring to claim 8, and have responded accordingly. More specifically, the Examiner indicates that the "between the magnetizations" language in the claim is improper. Applicants believe that "between the magnetizations" defines magnetization whose direction is fixed and magnetization whose direction changes in accordance with the external magnetic field. However, in order to expedite prosecution, Applicants amended claim 8 to clarify that "between the magnetizations" indicates where the magnetization occurs, whereas "opposite direction" indicates the directions of the magnetization.

Claim 8 stands rejected under 35 U.S.C. 103(a) as being obvious over Hayashi et al. (U.S. Patent No. 5,897,969). In response, Applicants amended claim 8 to define the middle layer as a metal layer, and respectfully traverse. Applicants respectfully traverse because the cited reference does not disclose or suggest a middle layer that is formed of a metal layer only, as in the present invention.

The Hayashi et al. reference discloses a magnetoresistive film that uses a Magnetic Tunneling MR (TMR) effect, which makes electric (tunneling) current run in a direction of the magnetoresistive film thickness. Consequently, the barrier layer 25 of the

Hayashi et al. reference must have at least a portion thereof formed of an insulating layer (Col. 9, lns. 24-30).

In contrast, the magnetoresistive film of the present invention uses spin valve MR effect which causes electric current to run through a surface of the magnetoresistive film.

As a result, the middle layer of the present invention is formed of a metal layer, and not an oxide or nitride insulating portion, as required in the Hayashi et al. reference. For these reasons, Applicants submit that it would not have been obvious to form the present invention, which includes a metal middle layer only, by using the teaching of the Hayashi et al. reference. Therefore, withdrawal of the §103 rejection to claim 8 is respectfully requested.

Claims 1-6 and 9-10 stand rejected under 35 U.S.C. 103(a) as being obvious over Hayashi et al. in view of Taniyama et al. (U.S. Patent No. 5,897,969). Applicants respectfully traverse the rejection because the cited references do not disclose or suggest forming a copper oxide layer directly on the free magnetic layer, or on the free magnetic layer via an oxide layer comprising a material fabricated by oxidation of a material constituting the free magnetic layer.

The present invention discloses that an oxide including a copper element has a Specular effect (Specular reflection effect), which enables propagation of electrons without a loss of spin information. As such, the present invention discloses forming the magnetoresistive film such that an oxide including a copper element is formed directly on the free magnetic layer, or on the free magnetic layer via an oxide layer comprising a material

formed by oxidation of a material forming the free magnetic layer. In particular, the copper oxide layer functions as a Specular layer that enhances the MR effect.

With respect to claim 1, the copper oxide layer generates a negative interlayer coupling field on the free magnetic layer. Applicants believe that this new advantage of the present invention is caused by the effect of the conduction electrons' spin, but do not believe it is caused by exchange coupling between the copper oxide layer and the free magnetic layer, because the copper oxide layer is non-magnetic.

In contrast to the disclosure of the present invention by Applicants, the Specular effect is not disclosed in the Hayashi et al or Taniyama et al. references. Rather, the magnetoresistive film in the Taniyama et al. reference uses a NiO layer as a magnetic domain controlling film. Since NiO is anti-ferromagnetic, Applicants believe that the NiO layer controls a magnetic domain in the MR layer, and uses exchange coupling between the NiO layer and the ferromagnetic MR layer. The Taniyama et al. reference further discloses that a copper oxide layer could be an alternative to control a magnetic domain of the MR layer. However, copper oxide is non-magnetic, which prevents exchange coupling from being used like a NiO layer. Accordingly, providing magnetic domain control by using a copper oxide is different than if one used NiO for magnetic domain control. For these reasons, withdrawal of the rejection to claims 1-6 and 9-10 is respectfully requested.


Since claim 7 depends upon claim 1, it necessarily includes all of the features of independent claim 1 plus additional features. Thus, Applicants submit that the §103 rejection of claim 7 has also been overcome for the same reasons mentioned above to

overcome the rejection of independent claim 1. Applicants respectfully request that the §103 rejection of claim 7 also be withdrawn.

For all of the above reasons, Applicants request reconsideration and allowance of the claimed invention. The Examiner should call Applicants' attorney if an interview would expedite prosecution.

Respectfully submitted,

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